Northfield News

June 2010

A Newsletter for the Friends and Clients of Northfield Information Services

Special Points of Interest:

- Main Article: Equity Risk, Credit Risk, Default Correlation and Corporate Sustainability
- Northfield Celebrates our 25th
- Tech Support Tip: Calculating Risk Using Flat Text Files
- Annual Conference Agenda-Colorado Springs

Inside This Issue:

Equity Risk, Credit Risk, Default Correlation and Corporate Sustainability *By Dan diBartolomeo*

Starting with Merton (1974), financial researchers have long understood the theoretical links between equity risk and credit risk. While "structural models" of credit risk such as Moody's-KMV have been available for some time, we have developed a new approach for the use of such models. In our approach, we derive the market-implied *expected life of a firm* based on the firm's stock price, balance sheet leverage and the equity risk forecast from our models. We first translate the equity risk forecast into a forecast of volatility of a firm's assets. An option framework similar to Merton (1974) and Leland (1994) is then used to derive an expectation of market implied expiration date of the option, which is a proxy for expected life of the firm. Two methods for improving estimates of default correlation are provided. We will also show empirical uses of the technique at both the firm level as a measure of credit risk and at the market level as a metric for systemic risk. Finally, we will also present evidence that the concept of corporate "sustainability" as broadly used by socially responsible investors appears to be supported, with purportedly sustainable firms having average expected lives which are longer than those of non-sustainable firms to a statistically significant degree.

Basic Contingent Claims Literature

The literature in this area begins with Merton (1974), where it is posed that the equity of a firm can be viewed as a European call option on the firm's assets, with a strike price equal to the face value of the firm's debt. For limited liability companies where there is no recourse to shareholders, this can alternatively be viewed as having lenders that are short a put option on the firm's assets. Rather than pay debts when due, shareholders can merely deliver the assets of the firm to the creditors as part of a bankruptcy process. Under this approach, it is assumed that default can occur only at the debt maturity, when substantial repayment is required.

(Equity Risk, Continued on page 7)

Northfield Celebrates Our Silver Anniversary

By Dan diBartolomeo

We are pleased to announce with great pride that this month is the 25th anniversary of the incorporation of the firm. During the past quarter century, the firm has grown to have nearly three hundred institutional clients in more than twenty countries. Our service offerings have broadened to include almost every aspect of the investment process such as risk assessment, optimization, performance attribution and asset allocation. We offer detailed coverage of almost every marketable security in the world, and have innovated in the analysis of illiquid investments such as real estate and private equity. Most importantly, we have continued to be true to our guiding principles of innovation, transparency and an uncompromising pursuit of analytical rigor. In essence, we are committed to give clients what we believe fits their needs, irrespective of current fashion or preference.

(Silver Anniversary, Continued on page 10)

Recent and Upcoming Events

2010 Northfield Annual Research Conference

The BROADMOOR • Colorado Springs, Colorado • August 30th-September 1st, 2010

We are pleased to announce our 23rd annual research conference at the BROADMOOR, in Colorado Springs, Colorado. The conference will officially begin on Monday, August 30th and end on Wednesday, September 1st.

The BROADMOOR

As is customary at Northfield events, a complete recreational and social calendar will accompany the working sessions. The BROADMOOR is a five star resort located on 3,000 lush acres under the shadow of Cheyenne Mountain in the Colorado Rockies, and offers an award-winning spa, swimming pools, outdoor hot tubs and tennis courts. Northfield will also be sponsoring a variety of activities for attendees on Monday morning including a mountain helicopter tour, Colorado River rafting, hiking in Cheyenne Canyon, golf and a Jeep tour.

We are accepting online registrations only. To complete your online registration, hotel requirements, and to view the full agenda with detailed presentation abstracts visit **http://www.northinfo.com/events.cfm**. Contact Kathy Prasad if you have any difficulties registering, **kathy@northinfo.com**, 617.208.2020.

Agenda

The agenda will consist of thirteen 1-hour presentations.

How to Respect the Principle of Equal Opportunity in Currency Investing
Marielle de Jong, University of Aix-Marseille

A New Approach to Measuring Volatility
Federico deVita, Acacia Management LLP

Comovement, Cross-sectional Volatility and the Potential for Active Management
Barry Feldman, Russell Indexes Research

Motivational Performance Measurement
Jarrod Wilcox, Wealthmate, Inc.

The Decomposition Verses The Decision-Evaluation of Active Risk-Adjusted Returns
Andre Mirabelli, Ph.D., Opturo

Redundency
Steve Kusiak, State Street Associates

A Note on the Returns From Minimum Variance Investing
Bernhard Scherer

The Role of News in Financial Markets
Peter A. Hafez, RavenPack

High-Frequency Equities Trading and Microstructural Cost Effects for Institutional Orders
Daniel J. Bukowski Sr., Quantitative Services Group, LLC

Problems with Using Four-Quarter Trailing Numbers in Investment Models
Marcus C. Bogue, Charter Oak Systems

Decision Critical Resources
David C. Reilly, Decision Critical Resources, Inc.

Return Forecast by Quantile Regression
Lingjie Ma, BMO Asset Management and Larry Pohlman, Alfred Berg

Equity Risk, Credit Risk, Default Correlation and Corporate Sustainability
Dan diBartolomeo, Northfield

Northfield Asia Seminar Series – Research on Investment Management and Risk

Hong Kong • Singapore • Sydney • Tokyo • September 22, 27, October 1 and 5, 2010

Northfield will be hosting four one day seminars in Hong Kong, Singapore, Sydney, and Tokyo. The purpose of the seminars is to showcase our research on various topics in investment and risk management to our growing list of Australian and Far East clients and prospects. The Tokyo seminar will take place at the Mandarin Oriental Hotel on September 22nd. The Hong Kong seminar will take place on September 27th at the Landmark Mandarin. The Singapore seminar will be held on October 1st at the Raffles Hotel and Sydney will take place on October 5th at the Quay Restaurant.

Further details will be posted to **http://www.northinfo.com/events.cfm** as the venues and agenda become finalized. Contact Nick Wade in Tokyo if you would like to attend, **+81 3 5403 4655** or e-mail: **nick@northinfo.com**.

Northfield European Seminar

London • November 2010

Northfield will be hosting a one day seminar in November. The purpose of the seminar is to showcase research on various topics in investment and risk management to our European clients.

Further details will be posted to **http://northinfo.com/events.cfm** as the agenda and venue become finalized. Contact Northfield's London office for further details, +44-(0)-20-7801-6260, **rupert@northinfo-europe.com**, or **david@northinfo-europe.com**

2010 Newport Annual Summer Seminar Wrap-up

Tennis Hall of Fame • Newport, Rhode Island • June 4, 2010

Northfield's annual summer seminar took place at the International Tennis Hall of Fame, in Newport, RI on June 4th. The seminar presented recent research and technical advances to an audience of Northfield clients and friends.

Tennis Hall of Fame

The agenda consisted of 7 presentations including: "The Mortgage Securities Collapse," "Mitigating Estimation Error in Optimization," "The Importance of Context in Investment Research," "ERM-Enterprise Risk Management," "Incorporation of Quantified News into Portfolio Risk Assessments," "Incorporation of Liquidity Risks Arising from Expected Trading Costs into Equity Risk Estimates," and "The Discretionary Wealth Hypothesis in an Arbitrage-Free Term Structure Approach to Asset-Liability Management."

As is customary, the seminar coincided with the USA Professional Championship of Court Tennis. Following the presentations, attendees viewed a court tennis demonstration by Northfield President Dan diBartolomeo, and then a Semi-Final Match between U.S competitors Camden Riviere and Steve Virgona. Riviere won the match and went on to defeat Rob Fahey, the reigning world champion. Court Tennis, or "real tennis" is the medieval sport that is the progenitor of all modern racquet sports. To learn more, visit the US Court Tennis Association site at **http://www.uscourttennis.org**.

After tennis on Friday evening, everyone enjoyed a relaxing oceanfront dinner party at The Chanler, on the Cliff Walk in Newport. The complete proceedings have been posted to our website at **http://www.northinfo.com/papersearch.cfm.** Northfield does not charge attendance for this event, however, we do accept donations on behalf of the Pine Street Inn, Boston's primary homeless shelter.

Calculating Risk Using Northfield Flat Text Files

By Mike Knezevich

When discussing factor variance contribution in the Risk Decomposition report, support frequently describes the value as a function of active exposures, factor variance and factor's covariance with other factors. In this article we discuss how Northfield data files are used to calculate the Risk Decomposition report in the Optimizer and glean some insights into how the three inputs impact variance contributions.

We illustrate the steps with a replicable example using the APT model files. The managed portfolio is an equal weighted two asset portfolio with Agilent Technologies Inc. (A) and Citigroup Inc. (C) benchmarked against the market weighted S&P 500 index.

Necessary inputs for the calculations are:

- Asset and portfolio weights (.hld)
- Factor exposure file (nYYYYMMDD.csv)
- Factor variance vector (nYYYYMMDD.mdl)
- Factor correlation matrix (wincorr.cor). The correlation matrix is modified to demonstrate the impact of covariance between factors.

Tracking variance contribution is comprised of two components, the factor and stock specific. The following steps may be applied to any Northfield model.

1.) Determine the active factor exposures using portfolio asset weights and the exposure file (.csv).

a.) Calculate weighted asset exposures by multiplying each asset's weight in the portfolio with its exposure to the factors. In our example the portfolio is equal weighted so each asset's factor exposures contribute 50% of the total portfolio's factor exposure.

.5 A + .5 C = PortExp

Factor		A		C		PortExp
Unexpected Inflation		-0.0475		-0.8195		-0.4335
Industrial Production		-0.6364		0.3491		-0.1436
Housing Starts		0.3735		0.4963		0.4349
Oil Price	.5X	0.0920	+.5X	0.0680	=	0.0800
Exchange Rate US$		0.0823		-1.5479		-0.7328
Credit Risk Premium		-21.9356		-17.0487		-19.4922
Slope Term Structure		-1.4909		-8.2112		-4.8511

b.) Calculate the benchmark's weighted exposures (BenchExp) as we did for the holding portfolio above, since this would include 500 assets we do not demonstrate the actual calculations but present the results below.

c.) Calculate active factor exposures (ActiveExp) by subtracting the benchmark's exposures from the portfolio exposures.

ID	Factor	PortExp		Bench EXP		Active EXP
*IN	Unexpected Inflation	-0.4335		-0.1286		-0.3049
*IP	Industrial Production	-0.1436		0.1419		-0.2856
*HS	Housing Starts	0.4349		0.1075		0.3274
*OP	Oil Price	0.0800	-	0.0019	=	0.0781
*EX	Exchange Rate US$	-0.7328		-0.6154		-0.1174
*RP	Credit Risk Premium	-19.4922		-11.5195		-7.9727
*SL	Slope Term Structure	-4.8511		-1.2821		-3.5690

2.) Next we must combine the factor variance vector (.mdl) with the factor correlation matrix (.cor) to create a covariance matrix.

a.) Begin by taking the square root of the factor variance vector in the model file (.mdl). This is the factor standard deviation vector (FacSTD).

FacSTD = sqrt(FactorVar)

Factor	FactorVar	FacSTD
Unexpected Inflation	572.97	23.94
Industrial Production	14.63	3.83
Housing Starts	1055.98	32.50
Oil Price	1321.83	36.36
Exchange Rate US$	90.82	9.53
Credit Risk Premium	0.84	0.92
Slope Term Structure	1.19	1.09

b.) We change the correlation matrix (wincorr.cor) to include a .3 correlation between OP and IN factors to illustrate the effect. This change is highlighted in red for any user wishing to replicate the results.

(Tech Support, Continued on page 5)

Tech Support, Continued from page 4

	*IN	*IP	*HS	*OP	*EX	*RP	*SL
*IN	1.0	0.0	0.0	0.3	0.0	0.0	0.0
*IP	0.0	1.0	0.0	0.0	0.0	0.0	0.0
*HS	0.0	0.0	1.0	0.0	0.0	0.0	0.0
*OP	0.3	0.0	0.0	1.0	0.0	0.0	0.0
*EX	0.0	0.0	0.0	0.0	1.0	0.0	0.0
*RP	0.0	0.0	0.0	0.0	0.0	1.0	0.0
*SL	0.0	0.0	0.0	0.0	0.0	0.0	1.0

c.) Construct the covariance matrix by multiplying the factor standard deviation by the correlation matrix and the factor standard deviation. For example to calculate the covariance matrix column for IN (CovM(*IN) multiply the factor standard deviation for each factor (FacSTD(i)) by the correlation of the factor with IN (corr(i,*IN)) then by the factor standard deviation of IN (FacSTD(*IN)) .

	Fac STD(i)	*	corr(i,*IN)	*	FacSTD(*IN)	=	CovM(*IN)
*IN	23.94	*	1	*	23.94	=	572.97
*IP	3.83	*	0	*	23.94	=	0.00
*HS	32.50	*	0	*	23.94	=	0.00
*OP	36.36	*	0.3	*	23.94	=	261.08
*EX	9.53	*	0	*	23.94	=	0.00
*RP	0.92	*	0	*	23.94	=	0.00
*SL	1.09	*	0	*	23.94	=	0.00

Calculating this column for each factor creates the covariance matrix (CovMatrix). The diagonal contains the factor variances since each factor is perfectly correlated with itself while the off-diagonal contains covariance between the factors.

	*IN	*IP	*HS	*OP	*EX	*RP	*SL
*IN	572.97	0.00	0.00	261.08	0.00	0.00	0.00
*IP	0.00	14.63	0.00	0.00	0.00	0.00	0.00
*HS	0.00	0.00	1055.98	0.00	0.00	0.00	0.00
*OP	261.08	0.00	0.00	1321.83	0.00	0.00	0.00
*EX	0.00	0.00	0.00	0.00	90.82	0.00	0.00
*RP	0.00	0.00	0.00	0.00	0.00	0.84	0.00
*SL	0.00	0.00	0.00	0.00	0.00	0.00	1.19

3.) Calculate the factor tracking variance contribution.

a.) Multiply the transpose of the active exposure vector by the factor covariance matrix by the active exposure vector.

ActiveExp^T * CovMatrix * ActiveExp

(See Figure 1 a the bottom of this page).

Add the factor variance and covariance across rows to determine the factor variance contribution. We extend this step to illustrate the impact of covariance.

	*IN	*IP	*HS	*OP	*EX	*RP	*SL		VarContr
*IN	53.25	0.00	0.00	-6.22	0.00	0.00	0.00		47.04
*IP	0.00	1.19	0.00	0.00	0.00	0.00	0.00		1.19
*HS	0.00	0.00	113.22	0.00	0.00	0.00	0.00		113.22
*OP	-6.22	0.00	0.00	8.06	0.00	0.00	0.00	=	1.85
*EX	0.00	0.00	0.00	0.00	1.25	0.00	0.00		1.25
*RP	0.00	0.00	0.00	0.00	0.00	53.59	0.00		53.59
*SL	0.00	0.00	0.00	0.00	0.00	0.00	15.19		15.19

Covariance between IN and OP decreases the variance contributions of both factors by 6.22 although they are positively correlated (corr =.3). This seemingly contradictory decease is explained by the portfolio being negatively exposed to IN and positively exposed to OP.

4.) The final component of tracking variance contribution is stock specific which is risk particular to a specific asset and as such is uncorrelated with the factors or other assets. For example the correlation between (A, C) = 0. The matrix contains a diagonal of stock specific risk with zeroes on the off diagonals. This simplifies the calculation as we can easily add the weighted portion of stock specific risk across assets.

(Tech Support, Continued on page 6)

$$
\begin{pmatrix} -0.30487 \\ -0.28558 \\ 0.327435 \\ 0.078097 \\ -0.11738 \\ -7.97268 \\ -3.56899 \end{pmatrix}^T
\times
\begin{pmatrix}
572.97 & 0.00 & 0.00 & 261.08 & 0.00 & 0.00 & 0.00 \\
0.00 & 14.63 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\
0.00 & 0.00 & 1055.98 & 0.00 & 0.00 & 0.00 & 0.00 \\
261.08 & 0.00 & 0.00 & 1321.83 & 0.00 & 0.00 & 0.00 \\
0.00 & 0.00 & 0.00 & 0.00 & 90.82 & 0.00 & 0.00 \\
0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.84 & 0.00 \\
0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 1.19
\end{pmatrix}
\times
\begin{pmatrix} -0.30487 \\ -0.28558 \\ 0.327435 \\ 0.078097 \\ -0.11738 \\ -7.97268 \\ -3.56899 \end{pmatrix}
$$

Figure 1

(Tech Support, continued from page 5)

a.) Square the active weight for each asset.

$$\text{ActiveWt}^2 = (\text{PortWt} - \text{BnWt})^2$$

b.) The stock specific risk column (Resid) is provided as a monthly standard deviation in the exposure file (.csv) and must be converted into annualized variance.

$$\text{Resid-Var} = 12 * \text{Resid}^2$$

c.) Stock specific variance contribution is:

$$\text{VarContr} = \sum(\text{ActiveWt}^2 * \text{Resid-Var})$$

(See Figure 2 below).

5.) Add the factor and stock specific variance contributions to calculate the total tracking variance. We can further take the square root to get the tracking error

Factor	VarContr
Unexpected Inflation	47.04
Industrial Production	1.19
Housing Starts	113.22
Oil Price	1.85
Exchange Rate US$	1.25
Credit Risk Premium	53.59
Slope Term Structure	15.19
Factor Tracking Variance	233.32
Stock Specific Tracking Variance	916.09
Total Tracking Variance	1149.41
Tracking Error	33.90

Comparing the calculated results to the optimizer results we see that our tracking errors are almost exact, 33.90 versus 33.97. **(See Figure 3 Below)**

The ability to calculate the risk decomposition using flat files allows users to construct the risk report outside the Optimizer GUI and determine the covariance impact on a factor variance contribution when the results may seem counter intuitive.

ID	Name	PortWt	BnWt	ActiveWt	ActiveWt²	Resid	Resid-Var	VarContr
A	Agilent	0.5	0.001115	0.4989	0.2489	8.6046	888.4656	221.1269
C	Citigroup	0.5	0.011363	0.4886	0.2388	15.5741	2910.6311	694.9601
								916.0869

Figure 2

	Factor	PortExp	BenchExp	ActiveExp	FactorVar	VarContr
1	Unexpected Inflation	-0.4335	-0.1286	-0.3049	572.9720	47.0382
2	Industrial Production	-0.1436	0.1419	-0.2856	14.6307	1.1932
3	Housing Starts	0.4349	0.1075	0.3274	1055.9800	113.2152
4	Oil Price	0.0800	0.0019	0.0781	1321.8300	1.8459
5	Exchange Rate US$	-0.7328	-0.6154	-0.1174	90.8187	1.2514
6	Credit Risk Premium	-19.4921	-11.5195	-7.9727	0.8431	53.5899
7	Slope Term Structure	-4.8511	-1.2821	-3.5690	1.1924	15.1884

Factor Tracking Variance	233.3223
Stock Specific Tracking Variance	920.7579
Total Tracking Variance	1154.0802
Tracking Error	33.9718
Total Risk of Portfolio	40.5587
Total Risk of Benchmark	13.2338
R-Squared	0.3850

Figure 3

(Equity Risk, continued from page 1)

The approach was extended by Black and Cox (1976) where they introduce a "first passage" model wherein default can occur before debt maturity, making the problem more similar to an American option. In this method, we assume that firm extinction will arise if the value of the firm's assets hits some boundary value that is expressed by the bond covenants or other collateral agreements. Two subsequent papers, by Leland (1994) and Leland and Toft (1996) further extend the method to account for the tax deductibility of interest payments, and the procedural costs of a bankruptcy. They estimate the extinction boundary value as the point where the salvage value of equity is maximized in a bankruptcy proceeding. A very useful computational advance is in Yaksick (1998), which provides a closed form solution to the expected optimal exercise of a perpetual American option.

Default Correlation

As corporate bankruptcies bond defaults are rare, generally singular events it is impossible to directly observe the pair-wise correlations of default among set of firms. When we talk about default correlation, we are either describing the variations in the frequency of events within large samples of firms, or are describing the time series variation in some measure of the likelihood of default, such as yield spread or bond rating. In some semantic sense, we might describe default correlation as the degree of dependence between firms such that the joint likelihood of both firms defaulting within a defined time interval is correctly specified.

Papers by Hull and White (2001) and Overbeck and Schmidt (2005) illustrate that you can estimate default correlation if you know the true (but generally unobservable) dependence between firms. The analytical framework of structural models provides the ability to estimate default correlation, given the correlation between the asset values of firms, as described in Zhou (2001). Frey, McNeil and Nyfeler (2005) extend the approach using a factor model that estimates correlations. Two papers by Giesecke (2003, 2006) try to improve the estimation of default correlation by including the correlation of changes to default boundaries, such as the tightening of bond covenants during periods of tight credit conditions.

We can also make the simplifying assumption that asset correlations are equal to equity return correlations. The book value of firm assets is a very incomplete measure of firm assets, so observing asset volatility and asset correlations across firms from financial statement data provides only very weak statistical estimates. Conversely, equity return volatility and correlation are readily observable for publicly traded firms. This approach is followed in Hull and White (2004), and apparently in the commercial service CreditMetrics.

The assumption that asset correlation equals equity return correlation is intuitive for situations where firm financial leverage is low and time horizons are short. However, Zeng and Zhang (2002) show that the asset correlations must be inferred from both the correlation of equity and debt components of the firm's balance sheet. A paper by DeSerigny and Renault (2002) also presents negative empirical results regarding this assumption.

Bring on the Factor Models

Given that almost all large asset managers have access to a commercial equity factor risk model, those same firms can estimate firm asset value correlations. From such an equity risk model, one can estimate the numerically equivalent full co-variance matrix among any set of included stocks, as described in diBartolomeo (1998). Qi, Xie, Liu and Wu (2008) provide a complex analytical derivation of asset correlations given equity return correlations.

If we have a multi-asset class risk model that includes both equity and fixed income securities, we can use the fundamental accounting identity to get a direct factor representation of asset volatility and equity, as Assets = Liabilities + Equity. Asset volatility is just equity volatility de-levered, adjusted for covariance with the market value of debt. When interest rates rise equity values usually drop. However, the market value of debt definitely declines, so leverage is sometimes reduced. Current accounting standards recognize this situation by allowing firms to show a profit by buying back their debt below par value in the secondary market. Using the same algebra as above, we can convert the factor representation to pair-wise asset correlation values across firms.

Proposed Method of Measuring Sustainability

With asset volatility and correlations estimated we can use our preferred structural model to estimate the default probability of a firm. We can use the method from Zhou to convert asset correlations to default correlations, allowing us to produce joint default probabilities across firms. However there are some fairly restrictive assumptions. First, the firm must have debt today. Secondly, the firm must have positive book value today and third, *the balance sheet leverage ratio must stay fixed in the future.*

In order to reduce the impact of these assumptions, we propose to reverse the concept of structural models away from default and focus on the sustainability of firms. We will pursue this by estimating the *market implied expected life* of firms using contingent claims analysis. Firms with no debt can now be included since it is possible that they get some debt in the future and default on that. This approach also provides a quantitative measure of the fundamental and "social" concept of *sustainability.*

(Equity Risk, Continued on page 8)

(Equity Risk, continued from page 7)

To estimate the expected life of a firm, we return to our basic option formulation of the problem. The option underlying is the firm's assets with asset volatility determined from the factor model as previously described. We propose to solve the option pricing model numerically for the implied expiration date of the option that equates the option value to the stock price. The time to the implied expiration date is the m*arket implied expected life of the firm.* Given that we are now allowing the expiration date to be the free parameter of the problem, we must include a term structure of interest rates so that as the implied expiration date moves around, the interest rate changes appropriately. If you choose the basic Black-Scholes as your option model, then you can solve BS for the implied time to expiration using a Taylor series approximation. More complex option models allow for stochastic interest rates and stochastic volatility of the assets.

Using an actual option pricing model is problematic for firms with no current debt or a negative book value. For these firms, we fill in the missing data points using a simple "distance to run" measure. We simply assume that non-survival will be coincident with stock price to zero, since a firm with a positive stock price should be able to sell shares to raise cash to pay debt. For example, if you have a stock with 40% annual volatility you need a 2.5 standard deviation event to get a -100 return. We can then calculate probability of a 2.5 standard deviation event under your choice of distributional assumptions.

To calibrate the firms estimated under the short cut measure as compared to the full option pricing procedure, we convert both measures to the median of the distribution of future survival in years. In essence, we ask the number of years such that the probability of firm survival to this point in time is 50%. The individual firm expected lives have highly skewed distributions, so we upper bound these values at 300 years. The individual firm "median of life" scores under the two methods are both converted to Z-scores, and the score from the distance to run measure is mapped into the concurrent cross-sectional distribution of Z-score for the option method.

An Example Empirical Study

In our first study, we will use a simple Merton model (Black-Scholes European put). Our equity return volatility forecast input will be obtained at each moment in time from the Northfield US Fundamental Model, which has a forecast risk horizon of one year. It might be argued that our "near horizon" risk model (forecast horizon two weeks) is more suitable for this study, but at the current time less data history is available.

Using the procedures described here, we estimated the median life measure monthly for all firms in Northfield's US equity universe from December 31, 1991 to March 31, 2010. We broke the universe of firms into three categories: all, financial firms and non-financial firms. It should be noted that there is considerable time series variation in the summary statistics. This variation arises from changes in stock price levels, interest rates, individual firm debt levels and in the Northfield risk forecasts (which encompass additional factors). Another important contributor is the time variation in the number of stocks publicly traded in the US and covered by the risk model, which ranged from 4660 at the start of the sample to a high of 8309 during 2000.

Given the recent financial crisis, it might be useful to begin with an examination of the summary information at the end of the study. Across the sample of 5068 firms, the median life expectancy was 23 years, with a mean of 22.18 and a capitalization-weighted mean of 25.71. For financial firms, a sample of 1132 firms had a median of 24 years, a mean of 21.69 and a capitalization weighted mean of 18.95. This result illustrates that the global financial crisis was very concentrated in large firms, as the capitalization weighted mean is substantially below other measures of central tendency. For the set of 3936 non-financial firms, the median life expectancy was 23 with a mean of 22.33 and a capitalization-weighted mean of 27.36.

There were also intuitive results at the individual firm level. Firms at the center of the crisis such as AIG, Citigroup and Goldman Sachs had very low life expectations of seven, six and six years respectively. Other "blue chip" firms such as Microsoft (32), IBM (30), Royal Dutch (39) and Exxon-Mobil (54) have life expectations of much greater length.

Across the entire time period of 220 months, the average sample size was 6587 firms, for a total of more than 1.3 million observations. The time-series average of the monthly medians, 21.63 years, with the times series average of the simple mean of 24.42 years and the capitalization weighted mean of 22.67. Particularly low values occur at several points in time, such as the recession period of 1992. At January 1992, the median was reduced to just 10 years with a mean of 13.20 and a capitalization weighted mean of 11.05. Conversely, the peak values were observed in January 2005 with a median of 30 years, a mean of 41.09 and a capitalization weighted mean of 32.36.

For the financial firm sub-sample, the average sample size was 1630 firms. The time series average of the monthly medians was 31.03, the time series average of the monthly means was 31.51 with the average capitalization weighted mean at 24.09 years. For non-financial firms, the average sample size was 4955. The time series average of monthly medians was 20.03 years, the times series average of the

(Equity Risk, Continued on page 9)

(Equity Risk, Continued from page 8)

monthly means at 22.13, with a capitalization-weighted mean of 22.23 years. Note that for the full time series, financial firms were expected to survive about 50% longer than non-financials. At last date in March of 2010, financials have slightly lower expected lives.

Our time series information also gives us another view of default correlations. Once the time series of expected lives have been calculated, we can estimate default correlation as the correlation of percentage changes in expected lives across firms. As expected lives shorten, changes of a given magnitude become larger percentage changes

Since correlation is a bounded function (-1 to +1) larger events drive the correlation values toward the extreme values. For example, two bonds whose issuers each have one day of expected life each will have a very high default correlation. We believe this approach will prove more satisfactory than trying to correlate movements in option-adjust yield spreads (OAS) since changes in bond prices are substantially impacted by liquidity effects.

Quantifying "Sustainability" of Firms and Nations

We can also use our model to test the empirical existence of the property of firm "sustainability". In this example, we will examine the FTSE/KLD DSI 400 stock index of US large cap firms considered socially responsible. A history of more than 20 years of the index constituents was reviewed. Typically about 200 firms are in common with the concurrent S&P 500.

Let's look in some detail at just two illustrative points in time. First, let us consider July 31, 1995. For the DSI 400, the median expected life is 17 years, a mean of 17.91 with a standard deviation 9.93. For the S&P 500 the median is 14, the mean is 15.40, and the standard deviation 9.28. This difference in means is statistically significant at the 95% level. Similar information is observed at March 31, 2010. For the DSI 400, the median is 30 years, the mean 26.39, with a standard deviation of 11.45. For the S&P 500, we have a median of 30, a mean of 24.93 and a standard deviation of 10.92. This difference in Means is statistically significant at 90% but not 95%.

However, we must recall that the two sets of index constituents typically had about 200 common members. If we remove all firms that are present in both indices to just examine the disjoint sets (DSI NOT S&P and S&P NOT DSI) we have obtained statistically significant differences in all periods tested, supporting the SRI concept of firm sustainability. This line of research will be the subject of a full forthcoming paper.

Obviously, if the market thinks public companies are not going to be around very long, the economy is in a bad way. Under the structural model, low equity valuations and high leverage equate to short life expectancy, while higher leverage can be sustained with higher growth rates that contribute to higher equity valuations.

We propose to use the "revenue weighted" expected life across the universe of firms as a measure of systemic stress on an economy. By revenue weighting we capture the stress in the real economy, since failure of a high revenue firm typically leads to job losses and substantial effects of supplier firms. We also avoid a bias introduced cap weighting since failing firms have small equity market capitalization and effectively fall out of the sample.

For the full sample, the maximum value of the revenue weighted mean was over 36 years, while the minimum of about 6.5 years was reached during the 1997 currency crisis. For the financial sub-sample, the lowest value was 4.55 years also during the same events, while the 2008 financial crisis only got values down into the nine to ten range. We find the time series properties of the revenue weighted mean to be a very intuitive representation of systemic stress in the global economy.

Our next research project based on this method will be to investigate the ability of the expected life data to predict changes in firm level credit ratings. To remove any possible biases in the credit rating changes, we have hand collected (copied from Barron's week by week) every credit rating down grade and upgrade since 1991. Our effort will be to relate changes in expected life and expected life values that are outliers within their rating category to subsequent changes in bond ratings. Eventually, we will use this mechanism to refine the credit risk expectations for both bond issuers and financial counterparties in our Everything, Everywhere model of risk.

Conclusions

Our research indicates that combining factor models and structural models of credit risk allows for consistent estimation of equity risk, credit risk and default correlation. Structural models based on contingent claims methods are a direct and informative approach to assessing the expected survival of firms. Empirical studies comparing constituents of SRI and conventional US stock indices reveal a positive and significant difference in expected lives, confirming the existence of "sustainability." Finally, we believe this technique will have usefulness as a measure of systemic risks in developed economies.

(Silver Anniversary, Continued from page 1)

Throughout our history, Northfield has brought numerous technical innovations to the field such as the first portfolio optimizer that could handle capital gain taxes, the first analytical models of REITs, the first risk models that combine specified and blind factors and the first commercial application of the Analytical Hierarchy Process to investment portfolios. This long list of innovations does not arise by accident, but rather as the direct result of the structure under which the firm has operated throughout its history. The most important of these is that Northfield is privately owned with essentially 100% of the equity held by employees of the firm, with neither any debt nor any other form of external ownership. This ownership structure has provided Northfield with the ability to continue to invest in long-range research and development without the pressure from public or private shareholders to emphasize current earnings and revenue growth, rather than the firm's inventory of intellectual property.

In this same vein, we are very proud of the fact that we have the most stable and experienced staff in the industry. Median tenure now exceeds eleven years. Since the turning of the millennium in the year 2000, staff turnover has actually been negative, with more former employers returning to Northfield than the handful who actually departed during the period. Staff stability is a key goal that is heavily supported. Our Boston headquarters includes staff-only recreation areas such as a gym, billiard room and video entertainment center. The firm's art collection is extensive, with more than eighty eclectic pieces ranging from local Boston artists to very prominent artists such as Peter Max and Salvador Dali. A mapped catalog of the collection provides visitors with the opportunity for a self-guided tour. Northfield also encourages employees to be active in community and charitable affairs, providing time for both and flexible work schedules and financial contributions.

We would like to take this moment to thank all our current and past employees, our clients around the world and all the friends we've made over the years that have been so supportive to what has become a successful and profoundly enjoyable enterprise. For those of us who have been privileged to ride along and occasionally guide this long journey, we very much look forward to the next twenty-five years.

Northfield Speaking Engagements

Northfield President Dan diBartolomeo spoke at the June 15th QWAFAFEW meeting in Boston. The topic was: "Linking Equity Risk, Credit Risk, Default Correlation and Corporate Sustainability."

On June 21st Dan presented "Incorporating Strategy Risk into Portfolio Risk Estimates" at the London Quant Group meeting.

Northfield Asia's Nick Wade discussed the three most common approaches to estimating a multi-factor risk model, along with Northfield's hybrid approach at the Sydney and Singapore CFA Societies seminars.

Northfield Asia's Yasuhiko Nakase spoke at the Northfield product seminar in Tokyo on June 11th where he discussed modeling risk with unlisted assets.

New Northfield Website Coming Soon

We plan on releasing our new and improved Northfield web-site in the third quarter of 2010. One of the main features we set out to improve was the overall search capability. We believe the new site will make it easier for our clients to search Northfield and third party related research publications. In addition, we will be introducing a blog section where our President, Dan diBartolomeo will share his answers to client questions that have come in over the years. Also, we have an improved partner page which will highlight more specifically which of our analytical services we are collaborating. We will be populating a "topics of interest section" which we will use to highlight timely industry related advancements in research and development. Our Events section is being revised to facilitate a more user friendly experience. Our goal is to make our website a "go to" tool in your daily workflow. We will make a formal announcement to clients once the new site is ready for use.

For a complete index of all former Northfield News articles, visit http://www.northinfo.com/documents/314.pdf

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